DENIM 2018
Knowledge Sharing Session

Electronics for Positioning Systems

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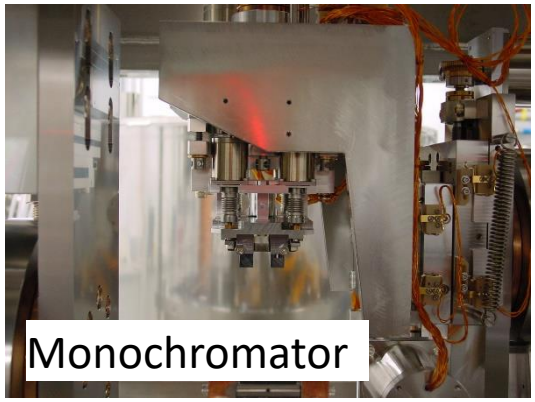
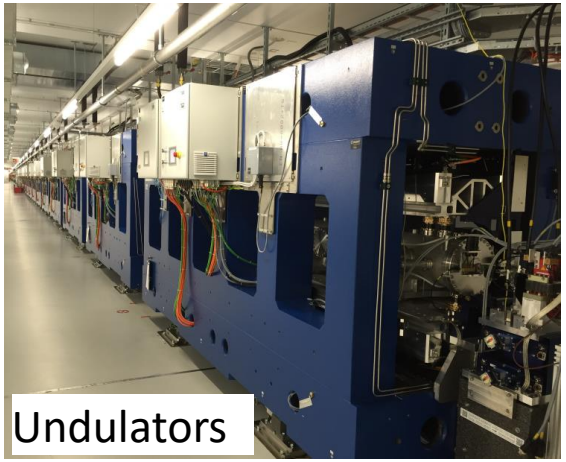
What can we learn from X-ray sources?

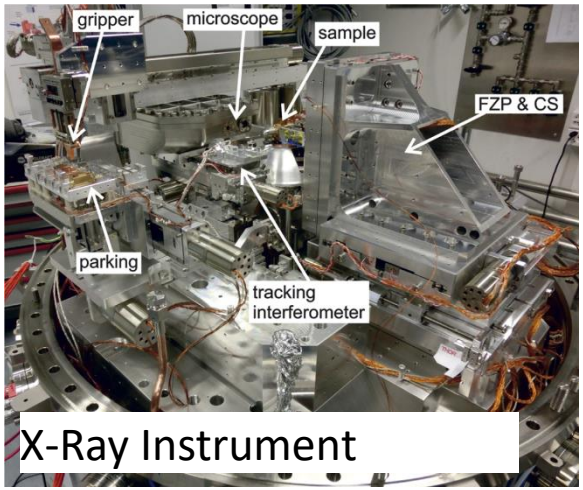
- Introduction presentation from Claude Pradervand on Motion Control at SLS and SwissFEL
  - Changes in systems
  - New systems required at SLS – Could be EtherCAT based
  - Motion control systems / PLCs / Temperature control all start to be possible from single systems
  - Complex control systems that we need to be able to present in software layers

Challenges for motion control

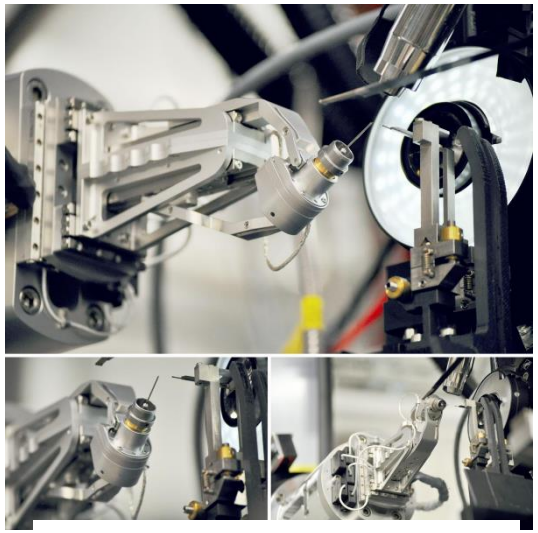
- Very big to very small loads → grams to tons
- High resolution for linear and rotary stages (down to nm or µdeg)
- High reproducibility required
- Large number of axis → requires standardization
- High reliability → many systems not (easily) accessible
- High radiation (x-rays, in accelerator also neutrons)
- Ultra High Vacuum (UHV ~10^{-8} mbar)
- Flexible, changing setups, easy and fast configuration
- Pulse synchronous operation in SwissFEL
- Cost effective → SLS >2000 axis


Monochromator

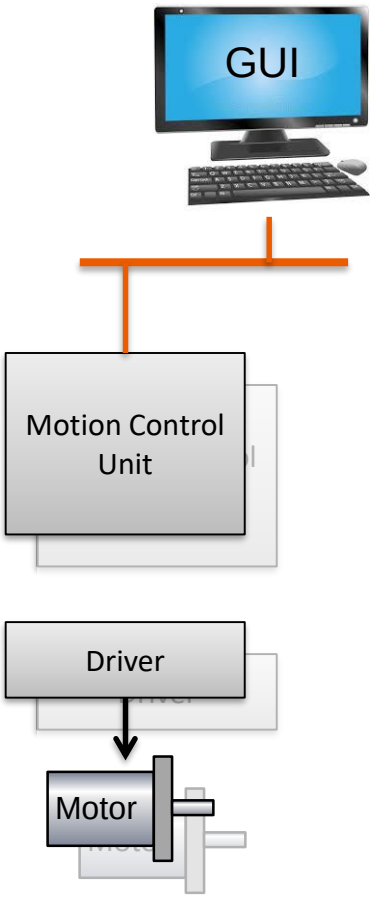

Undulators



X-Ray Instrument


Sample Environment

Current Motion Control Systems

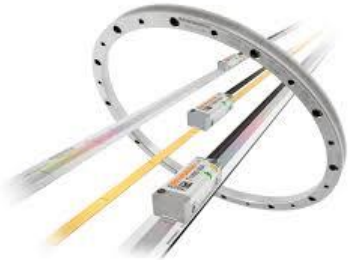


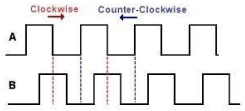
EPICS

Pro-Dex Accelerating Possibilities OREGON MICRO SYSTEMS

DELTA TAU NEW IDEAS IN MOTION...

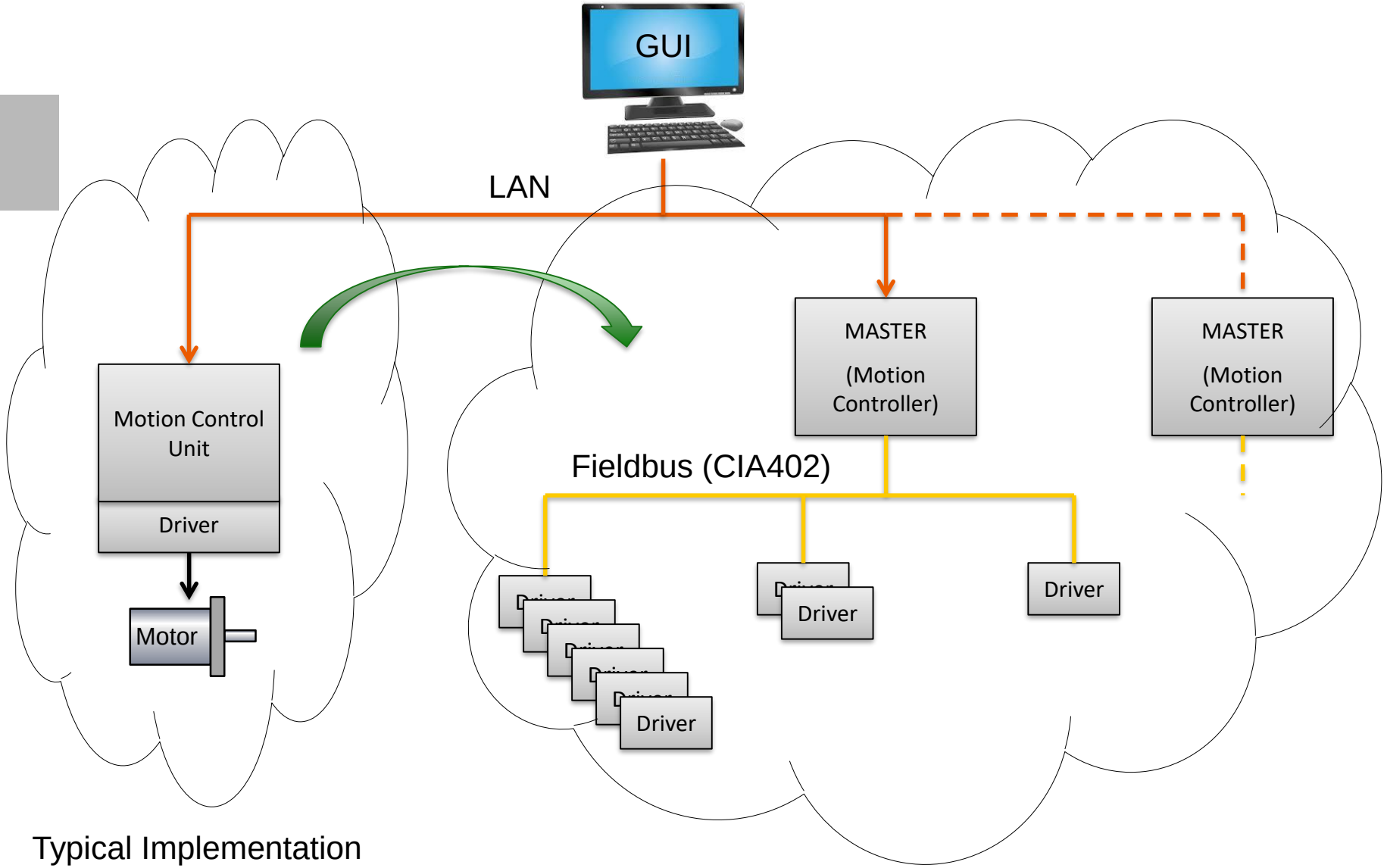
SLS 2001 MDU





IBiSS INTERFACE

Motion Control Architecture Shift



Typical Implementation

(SINQ, SLS, SwissFEL)

New Implementation

Similar challenges at both Neutron and Photon facilities in Motion

- Range in size of motion application
- Machinery Safety
  - X-ray – Insertion devices
  - Neutron – Increases in shielding mass and large samples
- Robotics

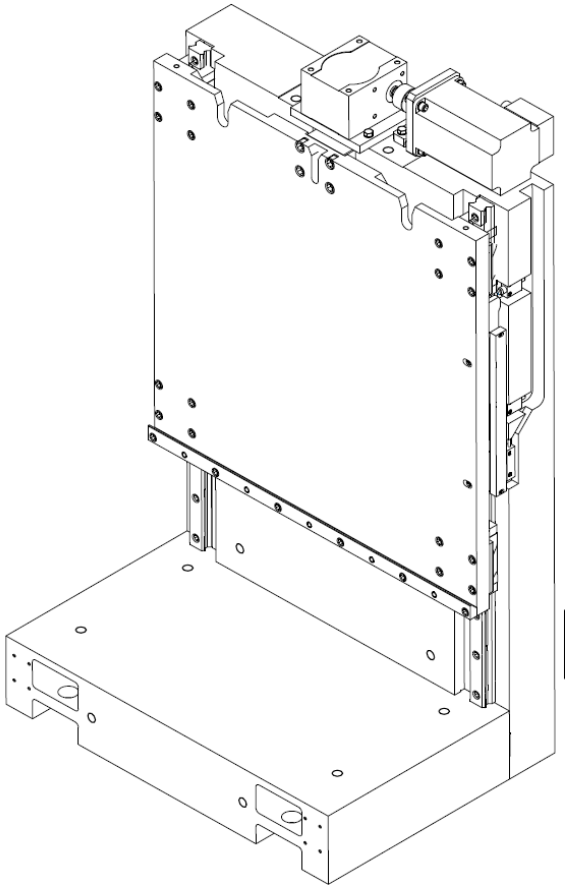
Could neutron sources make more use of Condition Monitoring for positioning components?

- Improving reliability
- Greater repeatability
  - in some cases we now need to get to levels that were previously only required at X-ray sources

"What has changed with this component? – It has always been working fine before"

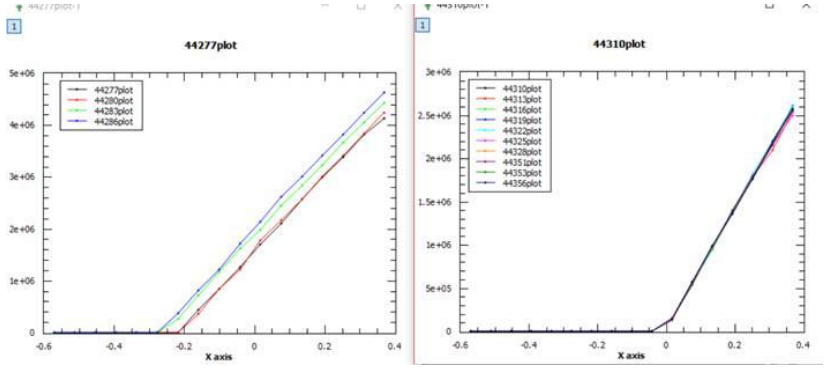
Issues with torque increases over component lifetime

- Torque – HZG had an example where an inline torque measurement device was used
- Temperature – ISIS example of potentially hot gearboxes where grease may be lost over time
- DESY and SLS had planned maintenance of components
  - Every 1 to 2 years

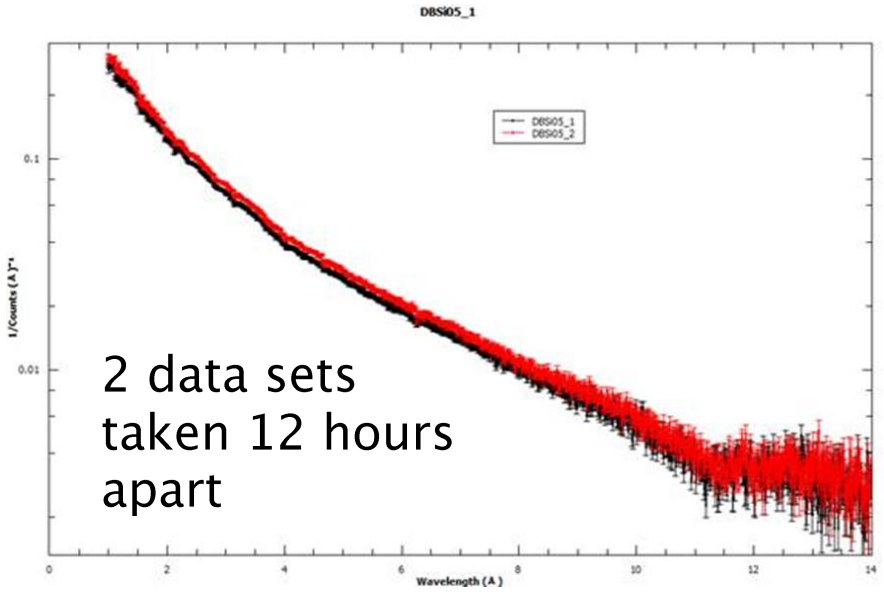


Issues with torque increases over component lifetime

- Focus on critical / hard to access components
- Set a baseline and plan for maintenance
- Data from ‘services’ control systems can be useful to us



Bad Good



Temperature control of experiment blockhouses / caves

- Temperature stability has a large affect on absolute positioning repeatability. This is particularly true when aiming for levels of under 5µm.
- Locating the air con sensor at the point where the most critical component was located
- Allowing temperature equalisation time when installing new SE equipment
- Improving tuning of air conditioning systems to remove oscillations

Issues with torque increases over component lifetime

- 'Smart' drives
  - Allowing feedback of condition parameters
- Position following error is an example of a parameter that may change over time
- Set up a new component and sample condition data to find max and min values
- Then gradually reduce the sampling frequency
- Archive data for when it may become useful
  (A fault that occurs in after 10 years etc.)